



Modeling and Simulation of CNS Systems



Topic: Planning the future of modeling and
simulation of aeronautical CNS systems

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Modeling and Simulation of CNS Systems



1 – What is the current state-of-the-art of modeling and simulation of aeronautical CNS systems?

Current Tools

1. OPNET
2. TAAM (Total Airport and Airspace Model)
3. ACES (Airspace Concepts Evaluation System)
4. Eurocontrol's RAMS (Reorganized ATC Mathematical Simulation)
5. FASTE-CNS
6. NS-2 (Network Simulator)
7. MATLAB Simulink
8. QualNet
9. STK (Satellite Tool Kit)
10. Boeing CNS Modeling Tool

Above tools were identified by the workshop participants. Other tools do exist.



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Current Models

- MITRE CAASD (OPNET)
 - ATN, VDL-2, VDL-3 (various flavors), Mode-S
 - Measure throughput and delay, protocol overhead
- CSU (OPNET)
 - VDL-2, VDL-3 (3T), VDL-4, AMSS (Inmarsat)
 - Measure throughput and delay
- Analex GRC
 - VDL-3, ADS-B/Mode-S, UAT, Satellite TDMA
- University of MD (OPNET/STK)
 - Satellite link (GEO and MEO)
- CSSI (Custom Tools, a combination of COTS tools)
 - Operational concepts (airborne self separation)
- Seagull (3rd party traffic generators based on custom tools)
 - Fast time, real time, VDL-3, Mode-S, ATCRB-S
- CNS Inc. / GRC (C#, MS .net)
 - Physical layer applications
- Tools also developed at MIT Lincoln Labs, APL at JHU



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2 – What is the end goal of CNS modeling and simulations? What are the requirements?

1. Answer fundamental R&D Questions
 - Tradeoff between different technologies
 - Ground-based vs. satellite-based communications links
 - CDMA vs. TDMA Systems
 - Guide R&D directions and standards development
2. Show the impact of CNS system performance on pilot, aircraft and controller behavior
3. Impact of CNS performance on operational concepts and vice versa
4. Impact of environment (weather, terrain etc.) on CNS performance requirements
5. Guide acquisition decisions



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3 – What are the modeling and simulation gaps?

1. Lack of collaboration within modeling/simulation research community
2. Adaptive behavior of people in the system.
3. Integrating CNS models with behavior based operational models.
4. Impact of CNS performance on separation standards.
5. Security Modeling
6. Safety Modeling
7. Common unified library of interacting models (e.g a national testbed filled with libraries like VDL-2, VDL-3, EPS, WAAS radars)
8. Lack of standardized traffic models and scenarios, and their inconsistent use.
9. Inadequate definitions for fidelity



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3 – What are the modeling and simulation gaps? (..contd.)

10. ATN vs. IPv6

- Mobile IPv6
- Interoperability of ATN applications in IPv6

11. Modeling of acquisition/policy making process

12. Modeling of future CNS landscape

13. Model transitions between technologies

14. Consistent validation of models



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4 – What is the recommended approach to eliminating these gaps and reaching the end goals?

1. Collaboration among model builders
2. Create a list of existing models and simulations.
3. Models should be designed with compatible model interfaces – so other models can use their outputs or contribute to the inputs.
4. Standardization of scenarios and metrics.